

The Burst and Transient Source Experiment on the Compton Gamma-Ray Observatory

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Since its launch in April 1991, the Burst And Transient Source Experiment (BATSE) has been returning a continuous stream of data and produced new discoveries in high-energy astrophysics. Not only have new properties of previously known objects been uncovered, but entirely new types of objects have been found. Collapsed objects such as neutron stars and black holes are found in our galaxy that produce gamma rays which vary greatly; some systems vary on a scale of months and others on a scale of milliseconds. These collapsed objects emit gamma rays when they pull matter from a companion star onto themselves, a process called accretion. The neutron stars in binaries also emit x rays when their surfaces burn in thermonuclear explosions. The neutron stars without companions emit gamma rays when their spin induces a current of relativistically moving particles. The latter systems form one of the two types of pulsars. The other type consists of a neutron star binary system undergoing accretion as the neutron star rotates.

The spin of the neutron star in both pulsar systems produces very regular variation in x-ray and gamma-ray emission; this regularity provides a strategy for finding new pulsar systems. Some systems show a rich variety of behavior; a recent example is the bursting pulsar (GRO J1744-28), discovered by BATSE in December 1995, which in flared from being unobservable to being the brightest gamma-ray source in the galaxy within 2 weeks. In addition to pulsed radiation, it also emitted brilliant bursts of gamma rays lasting only several seconds. Several other binary systems are

seen in the radio region to produce jets of matter that move at nearly the speed of light.

The bursting pulsar is near the center of our Milky Way Galaxy. More than 2,000 hard x-ray bursts from this object have now been detected, each having remarkably similar properties. Never before had an object been observed that displayed both the bursting behavior combined with the periodic behavior of a pulsar. Both the bursting (flaring) nature of this object along with the pulses (~0.5 sec) are shown in the average profile of many outbursts superimposed as shown in figure 162.

Other highly transient and variable objects have been studied by BATSE as well. Gamma-ray bursts, for example, are

nonrepeating blasts of radiation that last typically last a few seconds and come from random directions in the sky. Their origin still remains a mystery. Another example are the soft-gamma repeater objects (SGR's), different from gamma-ray bursts in that they produce lower energy bursts of radiation, are observed to repeatedly blast gamma rays and x rays into space, and are located within the disc of our own galaxy. The BATSE experiment on the Compton Gamma-Ray Observatory (GRO) is expected to operate for at least 5 more years, providing a wealth of new information about high-energy objects and phenomena in the sky.

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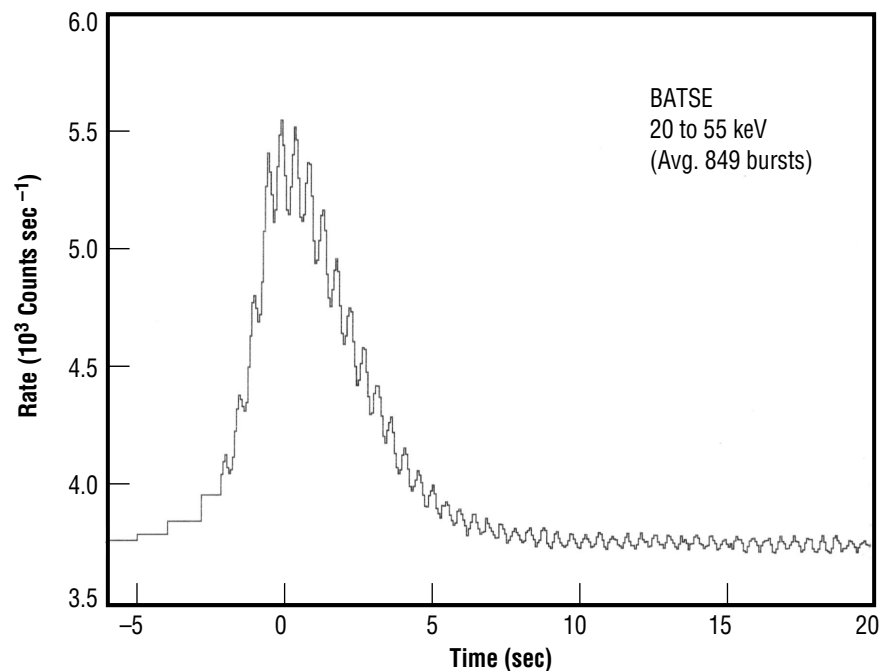


FIGURE 162.—The time profile of the Bursting Pulsar (GRO J1744-28). This unique Galactic object was discovered by BATSE in December 1995. It is the only known pulsed x-ray source to produce intense outbursts. Shown here is the superposition of a large number of outbursts, clearly showing the average shape of the bursts and the pulsed emission throughout.

University/Industry Involvement:

University of Alabama

Biological Sketch: Gerald J. Fishman is an astrophysicist in the Space Sciences Laboratory of MSFC and is head of the gamma-ray astronomy research group. His primary research has been in the fields of gamma-ray astronomy, nuclear astrophysics and background radiation in space. Presently, he is the principal investigator of the BATSE on the Compton GRO. He obtained his Ph.D. in 1969 from Rice University. 